POWER EQUIPMENT TECHNOLOGY

PURPOSE

To evaluate each contestant's preparation for employment and recognize outstanding students for excellence and professionalism in engine and equipment diagnostics, overhaul and repair of both liquid and air-cooled engines. It will also evaluate the ability to troubleshoot and possibly overhaul the power train components of a piece of powered equipment and/or machinery.

First, refer to General Regulations, Page 9.

CLOTHING REQUIREMENT

Official SkillsUSA light blue work shirt and navy pants, black or brown leather work shoes and safety glasses with side shields or goggles. (Prescription glasses can be used only if they are equipped with side shields. If not, they must be covered with goggles.) To purchase official work clothes, contact Midwest Trophy Manufacturing Co. Inc. by calling 800-324-5996 or order online at www.mtmrecognition.com/skillsusa/.

Note: Contestants must wear their official contest clothing to the contest orientation meeting.

ELIGIBILITY

Open to active SkillsUSA members enrolled in programs with small air-cooled engine repair or power equipment-related repair programs with that as its occupational objective.

EQUIPMENT AND MATERIALS:

1. Supplied by the technical committee:
   a. All necessary engines, engine parts, work stations, test stands, power equipment, gasoline, oil and all basic hand tools as well as necessary specialty tools
   b. Industry manuals, including service and repair instruction manuals

2. Supplied by the contestant:
   a. Precision measuring tools (to measure cylinder bore, crankshaft journals, etc.)
   b. V.O.A. meter capable of reading 10 amps, DC
   c. Tachometer capable of reading up to 12,000 rpm (for two-cycle power units)
   d. Ignition tester (to check spark) capable of testing the various manufacturers
   e. One-page, typewritten résumé

SCOPE OF CONTEST

The contest assesses understanding of two-cycle and four-cycle engines, 2 through 40 horsepower, and of both L-head and overhead valve design, as well as both single and twin cylinder design, drive train and hydraulic drive trains.

KNOWLEDGE PERFORMANCE

The contest will include a written knowledge exam based on an industry standard test. Additionally, the test could cover manufacturer's engines, parts identification, ordering and/or related equipment. There will also be the possibility of additional written portions during the day of the skill event.

SKILL PERFORMANCE

The contest will include a series of testing stations to assess skill performance.

CONTEST GUIDELINES

1. Contestants should have an understanding of engine theory, engine operation, diagnostic, failure analysis and repair and testing of engines and related power equipment as identified in the Standards and Competencies section below.
2. Contestants will demonstrate their ability to perform skills taken from the following areas:
   a. Ignition, Charging, Fuel and Governor Systems
   b. Starter, Cooling and Lubrication Systems
   c. Valves, Exhaust and Engine Block Systems
   d. Diagnostic and Failure Analysis
   e. Shop Procedures
   f. Business Operations
   g. Transmission/Power Train
   h. General Competencies

Standards and Competencies

PET 1.0 — Ignition, Charging, Fuel and Governor Systems

1.1 Ignition and Charging Systems
- 1.1.1 Understand and be able to disassemble ignition system, inspect and test ignition components
- 1.1.2 Show proficiency in testing coil/ignition modules
- 1.1.3 Repair/replace electronic ignition components

1.1.4 Test and troubleshoot equipment related switches and harnesses along with stators, regulators and any related wiring harnesses

1.2 Fuel Systems

1.2.1 Explain and be able to inspect, service, repair and adjust carburetors, gaseous fuel regulators and mixers

1.2.2 Inspect, clean and replace filters

1.2.3 Check fuel tanks and service and repair fuel pumps and solenoids

1.2.4 Test equipment-related fuel tanks, lines and related systems and understand the procedures for testing for compliance systems as they are related to emission requirements and standards

1.3 Governor Systems

1.3.1 Understand and be able to explain the various governor systems

1.3.2 Inspect, service and reassemble governors

1.3.3 Be able to understand and explain which components cause engines to increase or decrease in the number of revolutions per minute

PET 2.0 — Starter, Cooling and Lubrication Systems

2.1 Starter Systems

2.1.1 Recognize and be able to demonstrate the ability to inspect, service and adjust the various starting systems; use wiring schematics of related equipment systems

2.2 Cooling Systems

2.2.1 Recognize, test and troubleshoot both liquid and air-cooled cooling systems of both engines and equipment

2.2.2 Understand and recognize signs of heat related failures or problems

2.3 Lubricating Systems

2.3.1 Define and understand the various styles and types of lubrication systems

2.3.2 Demonstrate the ability to check oil levels and fuel/oil mixtures

2.3.3 Demonstrate the method of checking oil pressurized systems with the use of required tools

2.3.4 Understand and explain the various grades of oils and uses in the proper engines/equipment

PET 3.0 — Valves, Exhaust and Engine Block Systems

3.1 Valves

3.1.1 Be able to identify and service various types and styles of valve train components as well; explain why the sealing of these components is important

3.2 Exhaust Systems

3.2.1 Identify the various types of exhaust systems and explain how they relate to the engine and or equipment

3.2.2 Inspect and service exhaust and understand the procedures for testing for compliance systems as they are related to emission requirements and standards

3.3 Engine Block Components

3.3.1 Understand, identify and provide the necessary service/repair techniques to the various manufacturers within the industry; this could include disassembly, inspection and measuring of crankshafts, connecting rod bearings, journals, cylinders, piston and rings

3.3.2 Complete repairs to correct torque of critical fasteners and replace any gaskets and/or sealants

PET 4.0 — Diagnostic and Failure Analysis

4.1 Demonstrate the proper use of the various specialized tools of the industry. Be able to test crankcase vacuum, compression gauge, leak down testers, voltmeters/multimeters and any other required tools

4.2 Analyze failed engine components to determine the correct type of failure; determine best method to repair and estimate cost of repair

PET 5.0 — Shop Procedures

5.1 Demonstrate the proper techniques in the care and use of tools and equipment

5.2 Demonstrate the ability to work accurately with precision instruments

5.3 Use proper safety procedures; demonstrate ability to use service manuals and/or bulletins

5.4 Perform tasks within assigned time limits

5.5 Give a verbal response to a customer and answer customer-related problematic questions

5.6 Prepare equipment for delivery

PET 6.0 — Business Operation

6.1 Demonstrate the ability to look up proper part numbers by using paper, microfiche and/or electronic means available
6.2 Prepare both shop repair tickets and warranty claims
6.3 Demonstrate the ability to calculate costs accurately
6.4 Understand and operate equipment within equipment manufacturer's guidelines
6.5 Understand effective customer interaction and professional customer communications and relations

PET 7.0 — Transmission/Power Train

7.1 Understand the theory of transmission and transaxle components
7.2 Disassemble power train components, assemble power train components and diagnose and correct a potential problem
7.3 Understand the different types of transmissions and what types of lubrication systems are necessary for each

PET 8.0 — General Competencies

8.1 Basic reading and comprehension
8.2 Understand basic 2 and 4 stroke theory
8.3 Understand electrical theory
8.4 Understand carburetion theory and other related fuel systems
8.5 Read and follow schematics for hydraulics, electrical, etc.
8.6 Communicate effectively to others
8.7 Demonstrate basic computer skills

Additional Resources and Notes

Additional source material can be found on the manufacturers' Websites, through the local Central Distributors, Dealers, or Manufacturers within each State. Those manufacturers are:

- **Briggs & Stratton Corp.**
  www.briggsandstratton.com
- **Kohler Engines**
  www.kohlerengines.com
  www.kohlerplus.com
- **Tecumseh Products**
  www.tecumsehproducts.com
- **Shindiawa**
  www.shindiawa.com
- **MTD**
  www.mtdproducts.com
- **Simplicity**
  www.simplicity.com
- **Miller Welders**
  www.millerwelds.com
- **John Deere**
  www.johndeere.com

Scoring Criteria

Scoring criteria is based on 1,000 points. Breakdown is as follows:

Station 1: Written Test
Possible score: 100 points
Based on 50 questions worth two points each

Station 2: Parts Identification
Possible score: 75 points
Based on three manufacturers' products (25 point max from each manufacturer)

Station 3: Customer Service
Possible score: 100 points
Based on the ability to present written and verbal skills involving equipment

Station 4: Starter Repair
Possible score: 75 points
Based on the ability to service and or repair various starting systems

Station 5: Ignition Service
Possible score: 95 points
Based on the ability to service and/or test various ignition systems

Station 6: Failure Analysis
Possible score: 75 points
Based on the ability to diagnose or analyze failed components

Station 7: Internal Service
Possible score: 95 points
Based on performing service to an internal component

Station 8: Measurements
Possible score: 70 points
Based on the ability to take precise measurements on given mechanical items

Station 9: Running Adjustments
Possible score: 75 points
Based on the ability to set up and adjust manufacturers' engines to their specifications

Station 10: Two Cycle Service
Possible score: 90 points
Based on the ability to trouble shoot and service various two-cycle products

Station 11: Carburetion Service
Possible score: 75 points
Based on the ability to troubleshoot, service, or adjust various types of carburetors and or fuel systems

Station 12: Wild-Card Station
Possible score: 75 points
Based on a given set of instructions which may involve troubleshooting transmissions, generators or some other type of power equipment

Committee Identified Academic Skills
The technical committee has identified that the following academic skills are embedded in this contest.

Math Skills
- Use proportions and ratios to solve practical problems
- Use scientific notation
- Solve practical problems involving percents
- Measure angles
- Find surface area and perimeter of two-dimensional objects
- Find volume and surface area of three-dimensional objects
- Make predictions using knowledge of probability
- Make comparisons, predictions and inferences using graphs and charts
- Organize and describe data using matrixes
- Find slope of a line

Science Skills
- Plan and conduct a scientific investigation
- Use knowledge of patterns of cellular organization (cells, tissues, organs, systems)
- Describe basic needs of organisms
- Describe and recognize elements, compounds, mixtures, acids, bases and salts
- Describe and recognize solids, liquids and gases
- Describe characteristics of types of matter based on physical and chemical properties
- Use knowledge of classification of elements as metals, metalloids and nonmetals
- Describe and demonstrate simple compounds (formulas and the nature of bonding)
- Understand Law of Conservation of Matter and Energy
- Predict chemical changes to matter (types of reactions, reactants and products; and balanced equations)
- Use knowledge of potential and kinetic energy
- Use knowledge of mechanical, chemical and electrical energy
- Use knowledge of heat, light and sound energy
- Use knowledge of temperature scales, heat and heat transfer
- Use knowledge of sound and technological applications of sound waves
- Use knowledge of the nature and technological applications of light
- Use knowledge of speed, velocity and acceleration
- Use knowledge of Newton's laws of motion
- Use knowledge of work, force, mechanical advantage, efficiency and power
- Use knowledge of simple machines, compound machines, powered vehicles, rockets and restraining devices
- Use knowledge of principles of electricity and magnetism
- Use knowledge of static electricity, current electricity and circuits
- Use knowledge of magnetic fields and electromagnets
- Use knowledge of motors and generators

Language Arts Skills
- Provide information in conversations and in group discussions
- Provide information in oral presentations
- Demonstrate use of verbal communication skills, such as word choice, pitch, feeling, tone and voice
- Demonstrate use of nonverbal communication skills, such as eye contact, posture and gestures using interviewing techniques to gain information
- Analyze mass media messages
- Demonstrate comprehension of a variety of informational texts
- Use text structures to aid comprehension
- Identify words and phrases that signal an author's organizational pattern to aid comprehension
- Understand source, viewpoint and purpose of texts
- Organize and synthesize information for use in written and oral presentations
- Demonstrate knowledge of appropriate reference materials
- Use print, electronic databases and online resources to access information in books and articles

- Demonstrate narrative writing
- Demonstrate persuasive writing
- Demonstrate informational writing
- Edit writing for correct grammar, capitalization, punctuation, spelling, sentence structure and paragraphing

Connections to National Standards

State-level academic curriculum specialists identified the following connections to national academic standards.

Math Standards

- Numbers and Operations
- Measurement
- Problem Solving
- Reasoning and Proof
- Communication
- Connections
- Representation

Source: NCTM Principles and Standards for School Mathematics. To view high school standards, visit: standards.nctm.org/document/chapter7/index.htm. Select "Standards" from menu.

Science Standards

- Understands the structure and properties of matter
- Understands the sources and properties of energy
- Understands forces and motion
- Understands the nature of scientific inquiry

Source: McREL compendium of national science standards. To view and search the compendium, visit: www.mcrel.org/standards-benchmarks/.

Language Arts Standards

- Students apply a wide range of strategies to comprehend, interpret, evaluate and appreciate texts. They draw on their prior experience, their interactions with other readers and writers, their knowledge of word meaning and of other texts, their word identification strategies and their understanding of textual features (e.g., sound-letter correspondence, sentence structure, context, graphics)
- Students adjust their use of spoken, written and visual language (e.g., conventions, style, vocabulary) to communicate effectively with a variety of audiences and for different purposes
- Students use spoken, written and visual language to accomplish their own purposes (e.g., for learning, enjoyment, persuasion and the exchange of information)

Source: IRA/NCTE Standards for the English Language Arts. To view the standards, visit: www.readwritethink.org/standards/index.html.

Contest Scorecard

Items Evaluated	Possible Points
Station No. 1 — Written Test	100
Station No. 2 — Parts ID	75
Station No. 3 — Customer Service	100
Station No. 4 — Starter Repair	75
Station No. 5 — Ignition Service	95
Station No. 6 — Failure Analysis	75
Station No. 7 — Internal Service	95
Station No. 8 — Measurements	70
Station No. 9 — Running Adjustments	75
Station No. 10 — Two Cycle Service	90
Station No. 11 — Carburetion Service	75
Station No. 12 — Wild-Card Station	75
Sub Total	**1,000**
Résumé Penalty	_____
Clothing Penalty	_____
TOTAL	_____